

1                   **WHAT IS CLAIMED IS:**

2           1.     An irradiation system comprising:

3                   a radiation source arranged to emit a radiation beam along at

4                   least one beam path extending from the radiation source;

5                   an inner shield disposed around the radiation source for

6                   attenuating radiation generated by the radiation source, the at

7                   least one beam path extending through at least one path

8                   aperture in the inner shield;

9                   a first conveyor system for transporting articles through the

10                  beam path; and an outer shield for attenuating radiation

11                  generated by the radiation source disposed around the inner

12                  shield and around at least a part of the first conveyor system.

13       2.     The irradiation system of claim 1, wherein the irradiation system is

14                  arranged into an upper level and a lower level, the first conveyor system

15                  and the radiation source being located on the upper level, the irradiation

16                  system comprising: a second conveyor system located on the lower level.

17       3.     The irradiation system of claim 2, wherein the upper and lower level

18                  are separated by a support surface, the at least one beam path including a

19                  vertically extending beam path extending through a path aperture in the

20                  support surface for irradiating articles conveyed by the second conveyor

21                  system.

22       4.     The irradiation system of claim 1, wherein the first conveyor system

23                  comprises: a process loop disposed around the inner shield.

1        5.     The irradiation system of claim 1, wherein the outer shield forms a  
2        first chamber and a second chamber, the first and second chambers being  
3        separated by a dividing wall and, the first chamber housing the radiation  
4        source.

5        6.     The irradiation system of claim 5, wherein the inner shield  
6        comprises:

7                a removable inner module for allowing access to the radiation  
8                source.

9        7.     The irradiation system of claim 6, wherein the outer shield  
10       comprises:

11               a removable outer module for allowing access to the radiation  
12               source, the removable inner module and the removable outer  
13               module being sized so that the radiation source can pass  
14               through the inner and outer shield when the removable inner  
15               and outer modules are removed.

16       8.     The irradiation system of claim 5, comprising:

17               a wall in the second chamber extending substantially parallel  
18               to the dividing wall.

19       9.     The irradiation system of claim 5, wherein the first conveyor system  
20       comprises:

21               a process loop disposed around the inner shield; an entry  
22               conveyor system having a first end and a second end, the  
23               second end being arranged to convey articles to the process

1 loop; and  
2 an exit conveyor system having a first end and a second end,  
3 the first end being arranged to convey articles from the  
4 process loop, wherein the entry conveyor and the exit  
5 conveyor extend through an opening in the dividing wall.

6 10. The irradiation system of claim 9, wherein the exit conveyor system  
7 and the entry conveyor system extend through an opening in the outer  
8 shield.

9 11. The irradiation system of claim 5, the outer shield comprising:  
10 two side walls;  
11 a first end wall extending substantially perpendicularly to and  
12 connected to the side walls;  
13 and a second end wall connected to the side walls, wherein the  
14 dividing wall is substantially parallel to the second end wall.

15 12. The irradiation system of claim 11, comprising:  
16 a wall in the second chamber extending substantially parallel  
17 to the dividing wall.

18 13. The irradiation system of claim 1, wherein the inner shield  
19 comprises:

20 a removable inner module for allowing access to the radiation  
21 source; and

22 a removable outer module for allowing access to the radiation  
23 source, the removable inner module and the removable outer

1 module being sized so that the radiation source can pass  
2 through openings left in the inner and outer shields when the  
3 removable inner and outer modules are removed.

4 14. The irradiation system of claim 13, comprising:

5 at least one port in the removable outer module for allowing  
6 ballast material to pass out of the removable outer module.

7 15. The irradiation system of claim 1, comprising:

8 a ceiling over the upper level comprising a volume of ballast  
9 material, a portion of the ballast material covering the outer  
10 shield.

11 16. The irradiation system of claim 1, comprising:

12 a ceiling extending over the irradiation system and having at  
13 least one removable ceiling plug for allowing access to the  
14 radiation source.

15 17. The irradiation system of claim 16, wherein the removable ceiling  
16 plug allows for removal of a subassembly of the radiation source from the  
17 irradiation system.

18 18. An irradiation system arranged in an upper level and a lower level,  
19 comprising:

20 a radiation source in the upper level arranged to emit a  
21 radiation beam along a first beam path for irradiating articles  
22 on the upper level, and to emit radiation along a third beam  
23 path for irradiating articles on the lower level;

1                   an upper level shield disposed around the radiation source for  
 2                   attenuating radiation generated by the radiation source;  
 3                   a first conveyor system for transporting articles through the  
 4                   first beam path; and  
 5                   a second conveyor system for transporting articles through the  
 6                   third beam path.

7       19.   The irradiation system of claim 18, where in the third beam path  
 8       extends generally vertically from the upper level to the lower level.

9       20.   The irradiation system of claim 18, where in the upper and lower  
 10      level are separated by a support surface, the third beam path extending  
 11      through a path aperture in the support surface.

12      21.   The irradiation system of claim 198, wherein the third beam path  
 13      intersects the second conveyor system at a location below an area  
 14      surrounded by the upper level shield.

15      22.   The irradiation system of claim 21, wherein the lower level includes  
 16      a first chamber and a second chamber, the location where the third beam  
 17      path and the second conveyor system intersect being located in the first  
 18      chamber, and the first chamber being at least substantially covered by the  
 19      upper level shield.

20      23.   The irradiation system of claim 18, wherein the radiation source is  
 21      arranged to emit a radiation beam along a second beam path for irradiating  
 22      articles on the upper level.

23      24.   A method of removing a radiation source from an irradiation system

1 comprising a radiation source arranged to emit a radiation beam along a  
2 beam path, an inner shield disposed around the radiation source for  
3 attenuating radiation generated by the radiation source, and an outer shield  
4 disposed around the inner shield, the method comprising:

5           disconnecting a removable module of the outer shield from the  
6           outer shield; disconnecting a removable module of the inner  
7           shield from the inner shield; and removing the radiation  
8           source from the irradiation system through openings left by  
9           the removable modules.

10 25. The method of claim 24, wherein the step of disconnecting a  
11 removable module of the outer shield comprises:

12           disconnecting an outer plate of the removable module of the  
13           outer shield from adjacent portions of the outer shield;  
14           and disconnecting an inner plate of the removable module of  
15           the inner shield from adjacent portions of the outer shield.

16 26. The method of claim 25, wherein the step of disconnecting a  
17 removable module of the outer shield comprises:

18           removing ballast material from the removable module of the  
19           outer shield.

20 27. The method of claim 26, wherein the step of removing ballast  
21 material comprises:

22           opening a port in a bottom portion of the removable module of  
23           the outer shield; and

1                   allowing the ballast material to pass through the port.

2       28.   The method of claim 25, wherein the step of disconnection a  
3       removable module of the outer shield comprises:

4                   unbolting the removable module of the outer shield from the  
5                   adjacent portions.

6       29.   The method of claim 25, wherein the step of disconnecting a  
7       removable module of the inner shield comprises:

8                   removing ballast material from the removable module of the  
9                   inner shield;

10                  disconnecting an outer plate of the removable module of the

11                  inner shield from adjacent portions of the inner shield; and

12                  disconnecting an inner plate of the removable module of the

13                  inner shield from the adjacent portions of the inner shield.